82D CONGRESS
2d Session
HOUSE OF REPRESENTATIVES
DOCUMENT
No. 389

BELHAVEN HARBOR, N. C.

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED DECEMBER 12, 1950, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A REVIEW OF REPORTS ON BELHAVEN HARBOR, N. C., PARTICULARLY WITH A VIEW TO DETERMINING WHETHER THE EXISTING PROJECT FOR THE TIMBER BREAKWATERS AT THE MOUTH OF PANTEGO CREEK SHOULD BE MODIFIED. THIS INVESTIGATION WAS REQUESTED BY A RESOLUTION OF THE COMMITTEE ON RIVERS AND HARBORS, HOUSE OF REPRESENTATIVES, ADOPTED ON SEPTEMBER 25, 1945.

MARCH 10, 1952.—Referred to the Committee on Public Works and ordered to be printed, with one illustration

LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY,
Washington 25, D. C., February 26, 1952.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated December 12, 1950, from the Chief of Engineers, United States Army, together with accompanying papers and an illustration, on a review of reports on Belhaven Harbor, N. C., particularly with a view to determining whether the existing project for the timber breakwaters at the mouth of Pantego Creek should be modified. This investigation was requested by a resolution of the Committee on Rivers and Harbors, House of Representatives, adopted on September 25, 1945.

In accordance with section 1 of Public Law 14, Seventy-ninth Congress, the views of the State of North Carolina and the town of Belhaven, N. C., are set forth in the enclosed communications.

96396—52——1

Although the Bureau of the Budget advises that there is no objection to the submission of the report to Congress, it states that any estimate of appropriation for the initiation of this project, if authorized by Congress, must be justified in accordance with the policy set forth in the President's letter to the Secretary of the Army dated July 21, 1950, concerning curtailment of civil public works. The complete views of the Bureau of the Budget are contained in the attached copy of its letter.

Sincerely yours,

FRANK PACE, JR.,
Secretary of the Army.

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., February 12, 1952.

The honorable the SECRETARY OF THE ARMY,
(Through the Budget Officer for the Department of the Army.)

MY DEAR MR. SECRETARY: Receipt is acknowledged of your letter dated December 22, 1950, submitting the proposed report of the Chief of Engineers on a review of reports on Belhaven Harbor, N. C., requested by resolution of the Committee on Rivers and Harbors, House of Representatives, adopted on September 25, 1945.

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the report to Congress.

The President in his letter to you, dated July 21, 1950, directed that all civil public works be considered with the objective, as far as practical, of deferring, curtailing, or slowing down those projects which do not directly contribute to defense or to civilian requirements essential in the changed international situation. Therefore, any estimate of appropriation for the initiation of this project, if authorized by the Congress, must be justified in accordance with the policy set forth in the President's letter referred to above or any modifications thereof.

Sincerely yours,

WM. F. MCCANDLESS,
Assistant Director for Estimates.

COMMENTS OF THE STATE OF NORTH CAROLINA

STATE OF NORTH CAROLINA,
DEPARTMENT OF CONSERVATION AND DEVELOPMENT,
Raleigh, February 3, 1950.

Maj. Gen. LEWIS A. PICK,
Chief of Engineers, Department of the Army,
Washington, D. C.

DEAR GENERAL PICK: Our water resources engineer and our State forester have looked over the report in reference to the proposed improvements to the harbor at Belhaven; and, insofar as I am able to determine, we do not wish to interpose any objections but rather to

commend you for your efforts in this undertaking which, no doubt, will be of great value to that section of the State.

Sincerely yours,

GEORGE R. ROSS, *Director.*

COMMENTS OF THE TOWN OF BELHAVEN, N. C.

RESOLUTION, TOWN OF BELHAVEN, BEAUFORT COUNTY, N. C.

Whereas the Corps of Engineers, in compliance with a resolution adopted September 25, 1945, by the Committee on Rivers and Harbors of the House of Representatives, United States Congress, prepared and submitted a report on the advisability of modifying the existing project for Belhaven Harbor, N. C., to provide for a channel and turning basin in Wynne's Gut; and

Whereas the said report as submitted by the district engineer at Wilmington, N. C., and the division engineer, South Atlantic division, was favorable to the extent of providing a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot contour in Pantego Creek to a turning basin of the same depth 100 feet wide and 250 feet long just north of East Front Street, thence 10 feet deep and 60 feet wide to a point near the southwest edge of East Main Street, at an estimated cost of $13,500 to the United States, provided that local interest—

(*a*) Furnish, free of cost to the United States, as and when required, all lands, easements, rights-of-way, and spoil-disposal areas for the initial work and for subsequent maintenance;

(*b*) Hold and save the United States free from claims for damage that may result from the provision and maintenance of the improvement;

(*c*) Provide and maintain a suitable public landing in Wynne's Gut open to all on equal terms; and

(*d*) Remove the bridge across Wynne's Gut at East Front Street.

Now, therefore, be it resolved, That the town of Belhaven, N. C., acting through its board of aldermen, in consideration of the benefits to be derived from the aforesaid improvement, hereby agrees, as and when the same becomes necessary and proper, to provide the necessary local cooperation required for the proposed improvement.

Passed at its regular meeting November 10, 1950.

BOARD OF ALDERMEN, TOWN OF BELHAVEN.
By B. F. KEATON.

REPORT OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington 25, D. C., December 12, 1950.

Subject: Belhaven Harbor, N. C.
To: The Secretary of the Army.

1. I submit herewith for transmission to Congress the report of the Board of Engineers for Rivers and Harbors in response to resolution

of the Committee on Rivers and Harbors of the House of Representatives, adopted September 25, 1945, requesting the Board to review the reports on Belhaven Harbor, N. C., submitted in House Document No. 693, Seventy-fifth Congress, with a view to determining if it is advisable to modify the existing project in any way at this time, and particularly with a view to determining whether the existing project for the timber breakwaters at the mouth of Pantego Creek should be modified.

2. After full consideration of the reports secured from the district and division engineers, and after affording local interests full opportunity to be heard, the Board recommends modification of the existing project for Belhaven Harbor, N. C., to provide for a channel in Wynne's Gut 10 feet deep at mean low water and 60 feet wide from the 10-foot depth in Pantego Creek to a point near the downstream side of East Main Street, widened to provide a turning basin of like depth-100 feet wide and 250 feet long just upstream from East Front Street in Belhaven, generally in accordance with the plan of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $13,500 for construction and $500 annually for maintenance in addition to that now required; provided that responsible local interests give assurances satisfactory to the Secretary of the Army that they will (*a*) provide without cost to the United States, all lands, easements, rights-of-way, and spoil-disposal areas for the construction and subsequent maintenance of the project, when and as required; (*b*) hold and save the United States free from damages due to the construction and subsequent maintenance of the works; (*c*) provide and maintain at their own expense a suitable landing in Wynne's Gut open to all on equal terms; and (*d*) remove the existing wood bridge across Wynne's Gut at East Front Street.

3. After due consideration of these reports, I concur in the views and recommendations of the Board.

LEWIS A. PICK,
Major General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

DEPARTMENT OF THE ARMY,
BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington 25, D. C., October 14, 1949.

Subject: Belhaven Harbor, N. C.
To: The Chief of Engineers, United States Army.

1. This report is submitted in response to the following resolution adopted September 25, 1945:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Belhaven Harbor, North Carolina, submitted in House Document Numbered 693, Seventy-fifth Congress, with a view to determining if it is advisable to modify the existing project in any way at this time, and particularly with a view to determining whether the existing project for the timber breakwaters at the mouth of Pantego Creek should be modified.

2. The town of Belhaven, N. C., is on the left bank of Pantego Creek, a tributary of Pungo River, 130 miles south of Norfolk, Va. Belhaven Harbor comprises the lower 6,000 feet of the creek. Pungo River below the mouth of Pantego Creek flows south about 10 miles and enters Pamlico River near Pamlico Sound. Pantego Creek ranges in width from 3,400 feet at its mouth to 2,000 feet at the highway bridge 1.5 miles above the mouth. Wynne's Gut, a natural drain about 1,200 feet long, with widths from 20 to 100 feet, enters Pantego Creek from the left in Belhaven. Pungo River and Pantego Creek are sluggish, nontidal streams draining low coastal terrain. The existing Federal project for Belhaven Harbor, N. C., provides for a channel 12 feet deep at mean low water and 100 feet wide from deep water in Pungo River to a point in Pantego Creek about 800 feet downstream from the highway bridge, with a turning basin 300 feet wide and 800 feet long at the upper end; and for construction of timber breakwaters at the mouth of Pantego Creek. The project has been completed. Federal costs to June 30, 1948, were $126,687 for new work and $2,189 for maintenance, a total of $128,876. The latest approved estimate of annual cost of maintenance is $7,500. The Atlantic Intracoastal Waterway between Norfolk, Va., and the St. Johns River, Fla., with a project depth of 12 feet, traverses Pungo River from its mouth to a point 8.5 miles upstream from the mouth of Pantego Creek.

3. The tributary area comprises about 543 square miles of generally low-lying, sparsely settled terrain having a population in 1940 of 15,043, of which 2,360 resided in Belhaven. The inhabitants are engaged mainly in activities pertaining to production and processing of agricultural products, sea foods, and forest products. In addition to water transportation the region is served by railroads and highways. Terminal and transfer facilities in Belhaven Harbor consist of nine privately owned timber wharves including three bulk-oil terminals, all of which are open to the public. Commerce in the harbor averaged 24,130 tons annually during the 10-year period 1937 through 1946. It consisted mainly of receipts of marine products and logs. The commerce for 1946 was 16,071 tons, including receipt of 4,326 tons of marine products and 9,399 tons of logs and shipment of 1,174 tons of oysters in the shell. The commerce was handled by motorboats, sailboats, motor tankers, barges, and tugs with drafts up to 10 feet. Vessel traffic during 1946 consisted of 3,558 round trips by these craft.

4. Local interests desire a channel in Wynne's Gut 10 feet deep, 50 to 70 feet wide, and 1,200 feet long, and reconstruction of the existing breakwaters at the mouth of Pantego Creek. They claim that the existing breakwaters do not provide sufficient protection from strong south to east winds which render the loading and unloading of vessels difficult and hazardous. They believe that the desired improvement would provide a safe harbor for all types of small vessels using the inland waterway and connecting waters. They have indicated willingness to provide the prescribed local cooperation.

5. The district engineer has considered several plans of improvement to provide a safe harbor of refuge for small craft and to protect the navigation channel and the commercial water front. He finds that the existing timber breakwaters do not provide adequate protection for the harbor. However, he is of the opinion that the benefits from the modification of the present breakwaters or the construction of

new breakwaters would not be commensurate with the costs. Belhaven Harbor is favorably located to serve as a harbor of refuge and supply point for vessels traversing the intracoastal waterway and those operating on Pamlico River and the southern end of Pamlico Sound. The most practical plan of improvement to provide a safe harbor for small craft consists of a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot depth in Pantego Creek to a point near the southwest edge of East Main Street, widened to form a turning basin 10 feet deep, 100 feet wide, and 250 feet long north of East Front Street. He estimates the Federal and non-Federal first cost of the improvement at $13,500 and $6,250, respectively, a total of $19,750. The annual charges are $1,300. He estimates that a total average annual loss of $8,000 is now caused by wind action in the harbor of which $4,200 is from damage to about 100 locally based craft and $3,800 is from damage to wharves and water-front property. Annual benefits of $3,150 would accrue from the proposed improvement within Wynne's Gut due to the elimination of about 75 percent of the annual damage now suffered by locally based craft. The benefit-cost ratio is 2.42.

6. The district engineer concludes that the proposed channel and turning basin in Wynne's Gut will meet the needs of existing and prospective navigation and that the improvement is warranted. He accordingly recommends that the existing Federal project for Belhaven Harbor, N. C., be modified to provide for a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot contour in Pantego Creek to a turning basin of the same depth, 100 feet wide and 250 feet long just north of East Front Street, thence 10 feet deep and 60 feet wide to a point near the southwest edge of East Main Street, in Belhaven, all substantially as shown on the map accompanying his report, at an estimated first cost to the United States of $13,500 for dredging and $500 annually for maintenance in addition to that now authorized; provided that local interests furnish, free of cost to the United States, as and when required, all lands, easements, rights-of-way, and spoil-disposal areas for the initial work and for subsequent maintenance; hold and save the United States free from claims for damage that may result from the provision and maintenance of the improvement; provide and maintain a suitable public landing in Wynne's Gut open to all on equal terms; and remove the wood bridge across Wynne's Gut at East Front Street. The division engineer concurs.

7. Local interests were advised of the conclusions of the division engineer and were invited to submit additional information to the Board. Some communications were received objecting to the removal of the wooden bridge crossing Wynne's Gut at East Front Street. In order to permit local interests to fully express their desires, another public hearing was held by the district engineer at Belhaven, N. C., on April 6, 1949. At this hearing, all organizations and a majority of those present who expressed an opinion on the matter favored the improvement as recommended by the district and division engineers. Those opposing the removal of the bridge across East Front Street claim that its removal would greatly increase the distance that people on the west side of Wynne's Gut would be required to travel to reach the business section of Belhaven. There are only two dwellings and no business houses on East Front Street

between the bridge and the proposed Allen Street. The opponents also claim that a 200-foot low spot on East Main Street, United States Highway No. 264, would isolate part of the town from the hospital and from fire protection during high tides, if the bridge were removed. Town officials stated that the proposed Allen Street will be constructed at an early date to provide access to the west side of Wynne's Gut and the grade of the low reach in East Main Street will be raised. The district engineer states that an improvement of Wynne's Gut ending at the East Front Street bridge would be economically justified but that the basin would be too small to accommodate the vessels desiring to use it and would therefore be impracticable. It also appears impracticable to provide a wider basin below the bridge than that recommended in the report because of the piers and other structures on the east bank and the dwellings and hospital near the west boundary of the improvement recommended. The district engineer finds that a substantial majority of local interests favor the improvement as recommended and that the town officials seem willing and able to fulfill the recommended provisions of local cooperation. It appears that no appreciable danger or inconvenience would result from the removal of the East Front Street bridge. The district and division engineers recommend no modification in their reports.

VIEWS AND RECOMMENDATIONS OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

8. The Board of Engineers for Rivers and Harbors concurs generally in the views and recommendations of the reporting officers. The existing permeable breakwaters near the mouth of Pantego Creek provide limited protection for Belhaven Harbor, but a fetch of 0.6 of a mile between the breakwaters and the commercial water front results in troublesome and hazardous wave action in the harbor particularly during strong southeast storms. The proposed improvement in Wynne's Gut would provide a well-protected harbor for small craft and is warranted by a benefit-cost ratio of 2.42. The benefits from construction of new wing jetties or from modification of the existing breakwaters, either singly or in combination with the proposed improvement in Wynne's Gut, are not sufficient to warrant the expenditure of the necessary funds.

9. Accordingly, the Board recommends modification of the existing project for Belhaven Harbor, N. C., to provide for a channel in Wynne's Gut 10 feet deep at mean low water and 60 feet wide from the 10-foot depth in Pantego Creek to a point near the downstream side of East Main Street, widened to provide a turning basin of like depth, 100 feet wide and 250 feet long just upstream from East Front Street in Belhaven, generally in accordance with the plan of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $13,500 for construction and $500 annually for maintenance in addition to that now required; provided that responsible local interests give assurances satisfactory to the Secretary of the Army that they will (*a*) provide without cost to the United States, all lands, easements, rights-of-way, and spoil-disposal areas for the construction and subsequent maintenance of the project, when and as required; (*b*) hold and save the United States free from damages

due to the construction and subsequent maintenance of the works; (*c*) provide and maintain at their own expense a suitable landing in Wynne's Gut open to all on equal terms; and (*d*) remove the existing wood bridge across Wynne's Gut at East Front Street.

For the Board:

R. C. CRAWFORD,
Major General, Chairman.

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

Local interests desire a channel in Wynne's Gut at Belhaven, N. C., 10 feet deep and 50 to 70 feet wide, from the 10-foot contour in Pantego Creek to near East Main Street and either modification of the existing breakwaters or construction of new breakwaters closer to the harbor area. The district engineer finds that modification of the existing timber breakwaters or provision of new breakwaters is economically unjustified at this time. He finds, however, that a small-boat channel and turning basin in Wynne's Gut would eliminate a large part of the storm damages now suffered by small craft in the harbor and would be economically justified. He estimates that Federal first costs would be $13,500 and non-Federal, $6,250, a total of $19,750. Federal annual charges, including $500 additional for maintenance, are estimated at $1,030 and non-Federal at $270, a total of $1,300. The evaluated average annual benefits are estimated at $3,150; the ratioof benefits to costs, 2.42. Unevaluated and intangible benefits would come from increased safety and convenience of established and prospective navigation, a more adequate harbor of refuge, and safer areas for loading and unloading boat cargoes. The district engineer, therefore, recommends that the existing Federal project for Belhaven Harbor, N. C., be modified to provide for a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot contour in Pantego Creek to a turning basin of the same depth 100 feet wide and 250 feet long just north of East Front Street, thence 10 feet deep and 60 feet wide to a point near the southwest edge of East Main Street in Belhaven, all substantially as shown on the accompanying map, at an estimated Federal first cost of $13,500, with $500 annually for maintenance in addition to that now authorized; provided that local interests furnish, free of cost to the United States, as and when required, all lands, easements, rights-of-way, and spoil-disposal areas for the initial work and for subsequent maintenance; hold and save the United States free from claims for damage that may result from the provision and maintenance of the improvement; provide and maintain a suitable public landing in Wynne's Gut open to all on equal terms; and remove the wood bridge across Wynne's Gut at East Front Street.

DEPARTMENT OF THE ARMY,
CORPS OF ENGINEERS,
Wilmington, N. C., October 27, 1948.

Subject: Review of reports on Belhaven Harbor, N. C.
To: The division engineer, South Atlantic Division, Corps of Engineers, Atlanta, Ga.

AUTHORITY

1. This report is submitted in compliance with the following resolution adopted September 25, 1945:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Belhaven Harbor, North Carolina, submitted in House Document Numbered 693, Seventy-fifth Congress, with a view to determining if it is advisable to modify the existing project in any way at this time, and particularly with a view to determining whether the existing project for the timber breakwaters at the mouth of Pantego Creek should be modified.

The duty of preparing the report was assigned to the district engineer by the division engineer, South Atlantic Division, on October 18, 1945.

SCOPE OF SURVEY

2. A review of survey scope was authorized by the Chief of Engineers on November 8, 1945. In May 1946, a hydrographic survey was made of the harbor and entrance channel from deep water in Pungo River to the upper end of the existing project, including Wynne's Gut. Probings taken at the site of the existing breakwaters prior to their construction showed the materials to be sand, mud, clay, and shells. Other field investigations consisted principally of consultations with local interests. Letters requesting advice of any interest they might have in the report were sent to Congressman Herbert C. Bonner and various Federal, State, and local agencies; copies of replies from the agencies contacted are enclosed as appendix A[1] and are summarized in paragraph 72. The principal desires of interested parties and the reasons given in justification thereof are given hereinafter under "Improvement desired." Related office studies were devoted primarily to assembling up-to-date factual information from available data.

DESCRIPTION

3. Pantego Creek enters Pungo River from the northwest about 10 miles north of its confluence with Pamlico River near Pamlico Sound. The creek is about 3,400 feet wide at the mouth; 2,000 feet wide at the highway bridge, 1.5 miles above the mouth; and 50 feet wide at Pantego, N. C., 5.8 miles above the mouth, where it is crossed by a fixed highway bridge. At the mouth of Pantego Creek are two timber breakwaters with an opening 500 feet wide between them. The town of Belhaven is on the northeast shore of Pantego Creek at its confluence with Pungo River. Belhaven Harbor, N. C., comprises the lower 6,000 feet of Pantego Creek.

4. Pungo River rises north of Belhaven and flows generally southeast past Leechville (where it is crossed by a wood highway bridge with a steel drawspan) to the mouth of Wilkerson Creek, about 2.3 miles below the bridge. The stream increases in width from about 475 feet at Leechville to about 2,000 feet at the mouth of Wilkerson Creek. Thence Pungo River flows southwest about 2.5 miles, then west about 6 miles to the mouth of Pantego Creek. Between Pantego Creek and Pamlico River, Pungo River flows south, varies in width from 1.5 to 2.5 miles, and has maximum channel depths of 12 to 20 feet.

5. In Belhaven Harbor, a dredged channel extends from deep water in Pungo River to a point in Pantego Creek 800 feet east of the highway bridge, with a turning basin at the upper end; the authorized depth in the channel and turning basin is 12 feet. In June 1948, the controlling depth in the channel was 12 feet, and in the turning basin, 10.9 feet; the timber breakwaters were in good condition. This channel connects with the Intracoastal Waterway, which traverses Pungo River from its mouth to Wilkerson Creek where it enters the land cut to Alligator River. The authorized depth in the intracoastal waterway is 12 feet; the controlling depth in the section between Norfolk, Va., and Beaufort Inlet, N. C., is 11 feet (June 1948).

[1] Not printed.

96396—52——2

6. Wynne's Gut is a natural drain extending north from Belhaven Harbor to East Main Street about midway between Pamlico and Haslin Streets. It is about 1,200 feet long and from 20 to 100 feet wide. At East Front Street a fixed wood bridge spans the drain.

7. The existing timber breakwaters in Belhaven Harbor are alined about northeast-southwest across the mouth of Pantego Creek. The north breakwater, about 2,200 feet long, is separated from the south breakwater, about 1,900 feet long, by a 500-foot-wide navigation opening. A timber and stone shore connection is provided at the landward end of each breakwater. The breakwater design is a modification of that used in the construction of breakwaters at Burwells' Bay, Va. All timber is creosote-treated. Face piles are driven on 8-foot centers and are inclined 10° from vertical, slanting away from waves from the southeast. Two brace piles are driven behind each face pile, making angles of 40° with it in a direction normal to the face of the breakwaters and of 15° with the vertical in a direction parallel with the face of the breakwaters. The face of the breakwaters, inclined the same as the face piles, consists of 4- by 8-inch palings on 12-inch centers bolted to 8- by 8-inch wales bolted to the face piles. The palings, 4 feet 8 inches long, extend from elevation +0.2 to elevation +4.9. A seven-pile cluster is driven just channelward of the offshore end of each breakwater. The maximum depth of water at the north breakwater is about 8 feet, and the average, about 3 feet. The maximum depth of water at the south breakwater is about 12 feet, and the average about 7 feet.

8. Pungo River and Pantego Creek are nontidal streams, with very little slope, whose discharges have not been measured. Variations in water surface due to winds seldom exceed 2 feet above or below mean stage. Above the mouth of Pantego Creek the drainage area of the two streams, about 418 square miles, is low and flat; runoff is slow. Flood heights in the upper reaches are only a few feet above normal stages.

9. Southeast winds, which cause the greatest wave action in Belhaven Harbor, have a fetch of more than 34 miles across the west end of Pamlico Sound to the mouth of Pungo River; thence, with a slight deflection to the north, 10 miles to Belhaven Harbor. Wave action caused by east winds blowing down the 8-mile reach of Pungo River east of Pantego Creek is reduced by a shoal on the north side of the harbor entrance. Winds from other directions have a short fetch and do not produce pronounced wave action. The prevailing wind blows from the southwest. Sustained high-velocity winds from the southeast occur very infrequently.

10. Available information as to the effect of the existing breakwaters on wave action is limited. The only storm test since completion of the structures occured in September 1944, when the maximum wind velocity from the southeast was estimated at 56 miles an hour. There were no reports of inundation at Belhaven during that storm and storm damage was small. No wave observations were made by this office. Portions of the town are said to have been inundated during the September 1913 storm, when the southeast wind was estimated to have reached a velocity of 80 miles an hour. Data regarding the area covered and the depth of the floodwaters are not available. However, since information at hand indicates that the general ground elevation in Belhaven lies between 3 and 5 feet above

mean sea level and that many square miles of surrounding territory are at a lower elevation, it seems probable that the wind set-up (still-water level) was not more than about 4 feet above mean sea level.

11. If F (fetch) in statute miles is solved for in the Zuider Zee wind set-up formula ($S=0.00125 \frac{V^2F}{D} \text{ Cos } A$) using S (wind set-up) equal to 4.0 feet, V (velocity) equal to 80 miles an hour, D (average depth of water) equal to 18 feet, and angle A (angle of incidence) equal to zero, the computed fetch is 9 miles. Apparently hydrographic and topographic conditions in the narrower river reaches reduce the effect of winds in generating wind tide and waves to that of a fetch 9 miles rather than the fetch of 44 miles described hereinbefore; the computed fetch of 9 miles is therefore used hereinafter in computing wave heights. In determining the height of waves at Belhaven Harbor through use of the Stevenson-Molitor formula $H=0.17\sqrt{VF}+2.5-\sqrt[4]{F}$, using V equal to 80 miles an hour and F equal to 9 miles, H is found to be 5.3 feet. Assuming that about 55 percent of the wave height (2.9 feet) is above still-water level as set up by an 80-mile-an-hour wind (4.0 feet), the wave crest would be at elevation 6.9 during a southeast storm in which the wind velocity reaches 80 miles an hour. If, as in 1944, the wind velocity were 56 miles an hour, the wind set-up is computed as 2.0 feet and the wave height 4.6 feet, using the above formulas. In that case the wave crest would be at elevation 4.5.

12. Local interests claim that storm waves pass over, under, and through the existing breakwaters, and that waves of equal magnitude have been observed simultaneously on both the windward and leeward sides of the existing structures. Those claims appear reasonable. The face of the breakwaters consists of 4- by 8-inch palings on 12-inch centers extending from elevation +0.2 to elevation +4.9. Between the lower edge of the breakwater face and the bottom of the waterway, free passage of the oscillatory and translational motion of the water particles, and of differences in hydrostatic head, are impeded only by the supporting piling. The palings, with the 8- by 8-inch wales to which they are fastened, form a barrier nearly one-third of which is open to permit the passage of water. With a wind set-up of 2 feet or more the crests of large waves might pass over the breakwaters and the wave trough might pass under the structures. Photographs taken by this office shortly after completion of the breakwaters show comparatively calm water on the leeward side while waves about 1.5 feet high were attacking the structures. The still-water level is estimated to have been about 0.5 foot above the bottom of the palings at that time. It is likely, however, that only the crest of storm waves would be broken up by the breakwater.

13. The commercial water front at Belhaven is about 0.6 mile from the existing breakwaters. In solving the afore-mentioned formula for wave height, using V=56 mph and F=1 mile, it is seen that waves 2.8 feet high could be built up between the breakwaters and the commercial water front. Waves of that height can seriously damage small craft. Inasmuch as the existing breakwaters do not completely obstruct wave action, the waves could reform and then be built up

larger than the 2.8-foot waves computed above. Waves created by winds from the southeast pass through the 500-foot-wide navigation opening between the breakwaters but the inner harbor serves, at least partially, as a stilling basin reducing the height of those waves.

14. *Maps.*—Belhaven Harbor and contiguous territory are shown on the United States Geological Survey Map of North Carolina, United States Coast and Geodetic Survey Chart 1231, and on the accompanying map.

TRIBUTARY AREA

15. *General.*—Portions of Beaufort County on the north side of Pamlico River and of Hyde County on the east side of Pungo River, and small areas in southeast Washington County and southwest Tyrrell County are closer to Belhaven Harbor than to any other port. This territory is generally lowland, much of it in swamps and marshes. The area in Washington and Tyrrell Counties is sparsely populated and contributes little or no commerce to Belhaven Harbor. The southeast mainland part of Hyde County, while nearer to Far Creek, contributes commerce to Belhaven Harbor by truck. Because it has rail connections, is on the intracoastal waterway, and has access to Pamlico Sound, Belhaven Harbor will probably continue to serve a wider area than that nearer to it than to any other port. However, the data on "Tributary area" hereinafter include only that area nearer to Belhaven Harbor than to other harbors.

16. *Towns and population.*—Beaufort and Hyde Counties are predominantly rural. Swan Quarter, the county seat, in southwest Hyde County, and Scranton, on the east side of Pungo River, are the only towns in Hyde County nearer to Belhaven Harbor than to other ports. Engelhard, while on a navigable channel (Far Creek), will doubtless continue to be partially served from Belhaven due to the transportation connections at the latter. In addition to Belhaven, Pantego and Leechville are towns in Beaufort County tributary to Belhaven Harbor. Washington, the county seat and largest town in Beaufort County, is on Pamlico River and is not tributary to Belhaven Harbor. Population data from a United States Census Bureau publication are given in table 1.

TABLE 1.—*Population data*

	1920	1930	1940	Percent increase	
				1920–30	1930–40
United States	105,710,620	122,775,046	131,669,275	16.1	7.2
North Carolina	2,559,123	3,170,276	3,571,623	23.9	12.7
Beaufort County	31,024	35,026	36,431	12.9	4.0
Hyde County	8,386	8,550	7,860	2.0	−8.1
Tributary area	13,555	14,900	15,043	9.9	.9
Towns in tributary area:					
Belhaven	1,816	2,458	2,360	35.3	−4.0
Leechville					
Pantego	335	329	294	−1.8	−10.6
Scranton					
Swan Quarter	184	223	271	21.2	21.5

17. *Industry and resources.*—A résumé of industry and resources is given in paragraphs 18–22, and data related thereto are shown in tables 2 and 3. Statistics on agriculture, forests, and other resources

are based on the proportion of the total land area of the two counties that is included in the tributary area. Data on agriculture are taken from various publications of the North Carolina Department of Agriculture; timber products, from the North Carolina Industrial Directory and Reference Book, published by the North Carolina Department of Conservation and Development in 1938; water products, from the same directory and from the annual reports of the Chief of Engineers; and commercial and industrial establishments, from publications of the United States Census Bureau. All the data are in such form that the information relating to the tributary area of Belhaven Harbor can readily be determined.

18. *Agriculture.*—Farming is the most important occupation in Beaufort and Hyde Counties. Statistical data from publications of the North Carolina Department of Agriculture are given in table 2; except as noted, the figures are for 1944, and the averages for 1941–44.

TABLE 2.—*Agricultural statistics*

	Tributary area	
	1944	Average, 1941–44
Total acreage	347, 520	
Number of farms	[1] 1, 460	[2] 1, 473
Total farm acreage	[1] 120, 254	128, 726
Acres cultivated	[1] 46, 263	47, 303
Acres in farm woodland	[1] 67, 560	72, 006
Acres in pasture, idle or used for miscellaneous purposes	[1] 6, 431	8, 006
Number of cattle of all kinds	2, 586	2, 577
Number of milch cows	1, 038	1, 137
Number of hogs	9, 832	8, 500
Corn, tons	13, 355	15, 059
Cotton, do	516	599
Tobacco, do	2, 270	1, 896
Soybeans, do	3, 089	3, 310
Irish potatoes, do	5, 898	8, 336
Oats, do	1, 315	1, 226
Tame hay, do	3, 786	4, 000
Sweetpotatoes, do	1, 383	1, 192
Total farm products, do	31, 612	35, 618
Commercial fertilizer, do	7, 424	6, 989
Annual value of harvested crops	$3, 683, 458	$3, 002, 586

[1] 1945.
[2] 1940.

19. *Water products.*—Next to farming, the most important occupations in the area tributary to Belhaven Harbor are crabbing, oystering, fishing, and shrimping. The State industrial directory states that in 1936, 2,917,000 pounds of water products valued at $101,903 were taken by commercial fishermen in Beaufort County, and 3,625,500 pounds valued at $101,062, in Hyde County. The Annual Report of the Chief of Engineers for 1936 indicates that about 8,108,000 pounds of water products were received at Belhaven that year. Data on receipts of water products from the annual reports of the Chief of Engineers are shown in table 5.

20. *Timber.*—The timber industry is an important occupation in Beaufort and Hyde Counties. In 1936, about 81 percent of the land in the two counties was in forest, including farm woodland. The State directory states that, in 1936, saw timber was most accessible by road, water, and rail in Beaufort County, and partly accessible by water in Hyde County. During the past 10 years, more than 53

percent of the internal receipts of Belhaven Harbor has been rafted logs. Statistics on timber production are given in table 3.

21. *Manufacturing.*—Lumber and timber basic products are the principal items manufactured in the tributary area. In 1936, 2 manufacturing establishments employing 285 persons were engaged in the production of lumber and basic timber products in Belhaven. Other manufacturing establishments in the tributary area are small.

22. Data on commercial and industrial establishments are given in table 3.

TABLE 3.—*Data on industry and resources*

	Counties			Tributary area
	Beaufort	Hyde	Total	
Total acreage	531,840	405,760	937,600	347,659
Forests (1936):				
Acreage in forests [1]	435,000	330,000	765,000	283,530
Standing (1,000 feet board measure)	180,000	130,000	310,000	114,440
Annual production of sawmills (1,000 feet board measure)	27,219	4,000	31,219	10,416
Manufacturing (1939):				
Number of plants	22	1	23	7
Number of employees	650	----	650	207
Wholesalers (1939):				
Number	54	12	66	22
Value of sales	$7,500,000	$443,000	$7,943,000	$2,580,000
Retailers (1939):				
Number	455	104	559	191
Value of sales	$5,581,000	$424,000	$6,005,000	$1,961,000

[1] Includes farm woodland.

23. *Electric power.*—Transmission lines of the Virginia Electric & Power Co. serve southwest Beaufort County; a municipal plant serves Belhaven and surrounding areas; and the Pamlico Ice & Light Co. serves southeast mainland Hyde County.

24. *Transportation.*—Federal Highway 264, with its east terminus at Engelhard, passes through Belhaven and Washington, N. C.; at the latter it intersects Federal Highway 17, a major north-south highway. A branch line of the Norfolk Southern Railway, with its east terminus at Belhaven, joins the main line at Pinetown, N. C. At Washington, N. C., and Plymouth, N. C., that railroad connects with branch lines of the Atlantic Coast Line Railroad. Water transportation is available via Belhaven Harbor and the intracoastal waterway.

BRIDGES

25. No bridges cross the federally improved portion of Belhaven Harbor. A swing-draw highway bridge with two 40-foot openings crosses Pantego Creek 800 feet above the upstream end of the improved channel. This bridge was completed May 5, 1910, under plans approved by the War Department September 20, 1907. A wood bridge crosses Wynne's Gut on East Front Street in Belhaven. This bridge would have to be removed to provide unobstructed passage to the upper end of the requested improvement.

PRIOR REPORTS

26. Prior reports on Belhaven Harbor are listed in table 4.

TABLE 4.—*Prior reports*

	Document No.	Congress	Session	Portion of harbor	Nature of recommendation	Action by Congress
Dec. 7, 1912	H. Doc. No. 1098.	62	Third	Harbor and entrance.	Unfavorable to constructing a breakwater across the mouth of Pantego Creek.	None.
Mar. 4, 1927	H. Doc. No. 778.	69	Second.	---do------	Favorable to a channel 12 feet deep and 100 feet wide from deep water in Pungo River to a point about 800 feet east of the highway bridge, with a turning basin 800 feet long and 300 feet wide at the upper end.	River and Harbor Act of July 3, 1930, authorized project as recommended.
June 8, 1937	Not printed.	------	-------	---do------	Unfavorable to construction of breakwaters at the mouth of Pantego Creek.	None.
May 25, 1938	H. Doc. No. 693.	75	Third	---do------	Favorable to the construction of timber breakwaters at the mouth of Pantego Creek.	River and Harbor Act of June 20, 1938, authorized project as recommended.

EXISTING CORPS OF ENGINEERS' PROJECT

27. *Prior Federal improvement.*—There was no Federal improvement in Belhaven Harbor prior to the existing project.

28. *Existing project.*—The existing project for Belhaven Harbor, N. C., was authorized by the River and Harbor Acts of July 3, 1930, and June 20, 1938. It provides for a channel 12 feet deep at mean low water and 100 feet wide from deep water in Pungo River to a point in Pantego Creek about 800 feet downstream of the highway bridge, with a turning basin 800 feet long and 300 feet wide at the upper end; and for the construction of timber breakwaters at the mouth of Pantego Creek. Channel dredging was completed in 1931; the breakwaters in 1940. The costs under the existing project to June 30, 1948, were $126,687.41 for new work and $2,188.81 for maintenance, a total of $128,876.22. The latest (1938) approved estimate for annual cost of maintenance is $7,500. Average annual costs of maintenance for the channel and breakwaters between the completion of the channel in 1931 and June 30, 1948, were about $129. No expenditure for maintenance has been made since 1941, when $474.69 was spent. About $10,000 can be profitably expended for dredging in the turning basin and repairs of the breakwaters during fiscal year 1950. Annual maintenance costs will increase considerably as repairs of the breakwaters become necessary.

LOCAL COOPERATION ON EXISTING PROJECT

29. The River and Harbor Act approved July 3, 1930, authorizing the existing project dimensions of the channel and turning basin, pro-

vides that local interests give assurances satisfactory to the Secretary of War and Chief of Engineers that they will provide a suitable public terminal, under plans to be approved by the Chief of Engineers. The River and Harbor Act adopted June 20, 1938, authorizing timber breakwaters at the mouth of Pantego Creek, provides that local interests furnish, free of cost to the United States, necessary rights-of-way for initial work and for subsequent maintenance as may be required. Those provisions of local cooperation were fully complied with. The public terminal cost about $12,000 and rights-of-way are estimated to have a value of $1,000. Although local interests fulfilled the existing project requirements for local cooperation relating to the provision of a public terminal, they afterward leased that terminal to private interests. After authorization by the North Carolina Legislature the wharf was sold to private interests in 1948 for $5,500. The authorization required that the proceeds from the sale of the wharf be expended on improving Wynne's Gut. Town officials state that because of the rough water the wharf was so costly to maintain that it was impracticable for the town to do so.

OTHER IMPROVEMENTS

30. According to available information, private interests spent about $50,000 for dredging in Belhaven Harbor prior to Federal improvement. So far as known, there have been no other improvements by local interests except those under prescribed conditions of local cooperation.

TERMINAL AND TRANSFER FACILITIES

31. *Existing facilities.*—There are nine timber wharves, including three bulk-oil terminals, along the water front in Belhaven Harbor; all are privately owned and operated. One wharf, formerly owned by the town, has been sold to private interests. All wharves have highway connections and two have rail connections; none are equipped with mechanical freight-handling devices. All docks are open to the public without charge when not being used by their owners.

32. *Needed improvements.*—A safe harbor for small vessels, with a suitable public landing, is needed. It was stated at the public hearing that if the desired improvement in Wynne's Gut were made, the town would construct therein facilities for loading and unloading vessels.

IMPROVEMENT DESIRED

33. *Public hearing.*—A public hearing was held in Belhaven, N. C., March 21, 1946. Those attending included Hon. Herbert C. Bonner, Member of Congress; representatives of the North Carolina State Highway and Public Works Commission, the United States Coast Guard, and the local government; and a group of about 50 persons representing the banking, farming, fishing, manufacturing, mercantile, and petroleum interests of the area.

34. No written statements were received prior to the hearing. One general statement from the town officials of Belhaven and eight statements in letter form from local interests were submitted at the hearing. Subsequent to the hearing, one letter was received from persons inter-

ested in the requested improvement. Those written items are included in the minutes of the hearing as exhibits C through M.[1]

35. Proponents stated that the timber breakwaters completed in 1940 have improved harbor conditions in a general way, but have not provided the protection needed, especially for small vessels. They proposed that the existing project be modified by dredging a channel in Wynne's Gut 10 feet deep, 50 to 70 feet wide, and about 1,200 feet long, to provide a safe harbor for all types of small vessels using the intracoastal waterway and connecting channels. They stated that only one side of the former city dock, now privately owned, can be used in stormy weather; that the harbor area is too small to accommodate the number of vessels seeking a safe harbor; and that the town was not in a position financially to maintain the former city dock. Moreover, they stated that the cost of docking facilities in Wynne's Gut would be moderate; that three times as many boats could be accommodated; and that loading facilities for larger vessels would be provided. They asserted that benefits from the proposed improvement would accrue to navigation and business interests throughout the eastern seaboard and would be widely distributed.

36. Local interests stated that Belhaven Harbor is the only point between Norfolk, Va., and Morehead City, N. C., with fuel, supplies, rail connections, and communications available for yacht traffic; that Belhaven is the center of a great agricultural community and a logical place for intrastate and interstate commerce; that the present breakwaters do not provide sufficient protection from rough water caused by strong south to east winds; that the work of loading and unloading vessels is doubled and made more dangerous by the rough water pitching the vessels; and that, because of the expense, the town of Belhaven has not developed the harbor sufficiently to meet the requirements of national traffic that passes through the intracoastal waterway and the local traffic that desires to use it.

37. Proponents mentioned the fact that the Corps of Engineers issued a permit, dated November 27, 1945, to the town of Belhaven for dredging a channel in Wynne's Gut. They claimed that due to the nature of the benefits, the Government would be justified in providing the desired improvement. Proponents also stated that, when materials become available at reasonable prices, they desire Federal improvement of the breakwaters, using rock or sheet piling. No opposition to the proposed modification has been expressed.

38. The consensus seemed to be that improvements were desired in the following order:

(1) Provision of a channel in Wynne's Gut 10 feet deep, 50 to 70 feet wide, and about 1,200 feet long, with a suitable public landing.

(2) Reconstruction of breakwaters, using stone.

Several speakers expressed the opinion that the present city dock should be publicly operated. (It has since been sold (par. 29).)

39. Letters were written to all known officials and agencies who might have an interest in the study. Representatives of this office called on local interests, including local governmental officials and businessmen. No definite offer of local cooperation was made. That matter is discussed in "Proposed local cooperation" hereinafter.

[1] Not printed.

COMMERCE

40. In 1909, water-borne commerce in Belhaven Harbor totaled 163,040 tons valued at $1,507,175; in 1923, 106,909 tons valued at $2,427,490. In 1930, the year the dredged channel was authorized, commerce was 46,916 tons valued at $1,557,797, and in 1931, the year the channel was completed, commerce was 50,914 tons valued at $1,288,433. In 1941, the last year of operation before the war, commerce was 30,313 tons, and, in 1946, it was 16,071 tons. The principal receipts have been marine products (fish, oysters in shell, crabs, and shrimp), lumber, rafted timber, and petroleum products; the principal shipments have been box shooks, lumber, and agricultural products (soybeans, corn, cotton, hay, Irish potatoes, and oats). Data on commerce, from the annual reports of the Chief of Engineers for 1930–46, are given in table 5.

TABLE 5.—*Commerce, Belhaven Harbor*

[Short tons]

INTERNAL RECEIPTS

Year	Marine products	Petroleum products	Lumber	Logs		Other [1]	Total receipts
				Rafted	Barged		
1930	2,086	2,418	13,354	1,650		2,833	22,341
1931	2,735	3,084	4,368	8,630		1,794	20,611
1932	3,117	2,223	1,110	15,691		1,669	23,810
1933	3,646	2,185	5,854	14,346		2,254	28,285
1934	2,657	2,833	4,213	21,084		2,086	32,873
1935	2,985	2,256	3,668	18,212		1,616	28,737
1936	4,054	3,365	3,434	9,945		3,238	24,036
1937	5,190	4,006	3,904	18,802		2,564	34,466
1938	4,905	4,115	2,022	17,964		551	29,557
1939	2,894	3,877	52	11,177		605	18,605
1940	2,876	4,369	161	7,137		1,729	16,272
1941	3,019	7,305		18,602		311	29,237
1942	3,058	6,417		22,201			31,676
1943	2,930	1,228		9,520	3,173		16,851
1944	7,149	33		10,069	3,653		20,904
1945	3,934	91		7,146	8,600	51	19,822
1946	4,326	891	163	6,203	3,196	118	14,897

[1] Includes fertilizer, vegetable food products, building materials, salt, and other miscellaneous items of commerce.

INTERNAL SHIPMENTS

Year	Box shooks	Lumber, poles, and crossties	Agricultural products	Oyster-shells	Rafted timber	Oysters in shell	Other [1]	Total shipments	Total commerce
1930	22,200	960		500			915	24,575	46,916
1931	26,220	2,650	1,030	250			153	30,303	50,914
1932	14,250		2,388	625			292	17,555	41,365
1933	16,794	190	565				91	17,640	45,925
1934	24,510	50	905	135			197	25,797	58,670
1935	14,250	344	652	79	1,890		363	17,578	46,315
1936		991	1,065		17,010		1,217	20,283	44,319
1937		604	828	1,070			749	3,251	37,717
1938		56	106	800			258	1,220	30,777
1939		46	315				246	607	19,212
1940		27	41				197	265	16,537
1941		775	140				161	1,076	30,313
1942		702						702	32,378
1943								0	16,851
1944								0	20,904
1945		290				425		715	20,537
1946						1,174		1,174	16,071

[1] Includes ice, fertilizer, petroleum products, cotton, coal, fuel wood, building materials, and other miscellaneous items of commerce.

41. *Internal water-borne receipts.*—During the period 1930–40, annual lumber receipts averaged about 3,830 tons, with a maximum of 13,354 tons in 1930. No lumber was received by water between 1940 and 1946. Marine products, rafted timber, and petroleum products have been the principal annual internal receipts. Since 1943 considerable quantities of logs have been barged to Belhaven. During the 17-year period 1930–46, the average annual receipts of marine products were 3,621 tons; rafted timber, 12,846 tons; and petroleum products, 2,982 tons. The maximum amount of marine products, 7,149 tons, was received in 1944; rafted timber, 22,201 tons, in 1942; and petroleum products, 7,305 tons, in 1941.

42. *Internal water-borne shipments.*—Through 1935, shipment of box shooks was one of the major items of commerce but none have been shipped by water since then. Lumber and agricultural products were shipped in substantial amounts through 1937 but have not moved by water in quantity since that year. In 1941, 1942, and 1945, large shipments of poles were made. In 1945 and 1946, oysters in shell were shipped from Belhaven.

43. *Trend.*—Prewar (1936–40) internal receipts were irregular but included four items (marine products, rafted timber, lumber, and petroleum products) handled annually in varying amounts. Internal shipments from Belhaven during that period declined steadily. The total commerce in 1946 was slightly less than that recorded in 1940. Among the possible reasons for the over-all decline in commerce are the increased use of truck transportation for some items, disruption of traffic due to wartime conditions, and lack of adequate protection in Belhaven Harbor for small vessels. The prewar trend to ship lumber and agricultural products by truck along the coast of North Carolina will probably continue; it is unlikely that appreciable amounts of those commodities will be shipped from Belhaven by water in the future. The water shipment of oysters in shell in 1946 increased greatly over the first such shipment by water in 1945. It is believed that receipts of marine products and rafted or barged timber will at least be comparable with prewar tonnages, and that petroleum product receipts will exceed the prewar level.

VESSEL TRAFFIC

44. *Type and destination of vessels.*—Marine products are transported from Pamlico Sound and tributary streams in motor and sail vessels drawing 2 to 7 feet. Motor tankers and barges drawing 6 to 10 feet deliver petroleum products to Belhaven and other ports along the Intracoastal Waterway and adjacent waterways. Logs are moved to Belhaven either in rafts towed by motorboats or in barges drawing about 8 feet towed by tugs. A motor freight boat drawing about 8 feet loaded transported general merchandise and fertilizer between Norfolk, Va., and Belhaven prior to the war. About 300 recreational craft drawing 3 to 6 feet visited Belhaven in 1941. Data on vessel traffic, obtained from the annual reports of the Chief of Engineers from 1930 through 1946, are shown in table 6; trips and drafts of vessels using Belhaven Harbor in 1946, taken from the 1947 Annual Report of the Chief of Engineers, are shown in table 7.

45. *Trend.*—During the period 1930–46, substantial use was made of Belhaven Harbor for water transportation. Vessel traffic in 1946

was at least four times that recorded in 1930. During the war the harbor was used by numerous small vessels in defense service as they moved north and south on the Intracoastal Waterway. In 1946 the net registered tonnage of vessels using the harbor was greater than that for any year since 1934 except 1945. In-bound trips of vessels drawing 9 and 10 feet were recorded in 1946 for the first time since 1942 and 1943. Seasonal recreational craft are said to have visited the locality in greater numbers since the war. Since numerous surplus war craft are being converted to commercial use and since Belhaven is an established sea-food center and port of call for recreational craft, it is believed that vessel traffic in the harbor will continue to exceed prewar traffic.

TABLE 6.—*Trips of vessels for year and draft indicated, Belhaven Harbor*

IN-BOUND

Year	Draft (feet)						Net registered tonnage
	10	9	7–8	5–6	2–4	Total 2–10	
1930			51	144	601	796	33,845
1931			101	293	452	846	34,567
1932			38	221	397	656	21,976
1933			44	263	501	808	25,376
1934			160	208	497	865	45,026
1935		24	138	208	535	905	34,226
1936		53	167	428	470	1,118	26,444
1937	74	19	96	735	620	1,544	30,503
1938	71	9	38	742	462	1,322	24,865
1939	60	12	36	491	606	1,205	19,604
1940	61	12	43	258	2,190	2,564	24,959
1941	60	19	168	319	2,895	3,461	26,568
1942	42	17	188	318	2,825	3,390	22,654
1943		26	127	407	2,139	2,699	19,028
1944			153	711	3,375	4,239	29,232
1945			157	571	3,135	3,863	35,422
1946	40	14	109	465	2,930	3,558	34,876

OUT-BOUND

1930	13	13	97	102	571	796	33,845
1931	15	15	36	66	714	846	34,567
1932	13	12	13	66	552	656	21,976
1933	15	14	15	263	501	808	25,376
1934	22	21	91	215	516	865	45,026
1935	13	12	91	252	537	905	34,226
1936			126	134	858	1,118	26,444
1937		2	145	338	1,059	1,544	30,503
1938			80	434	808	1,322	24,865
1939		12	60	352	781	1,205	19,604
1940		12	61	148	2,343	2,564	24,959
1941		15	213	116	3,117	3,461	26,568
1942		2	230	98	3,060	3,390	22,654
1943			153	84	2,462	2,699	19,028
1944			127	64	4,048	4,239	29,232
1945			115	178	3,570	3,863	35,422
1946			82	146	3,330	3,558	34,876

TABLE 7.—*Trips and drafts of vessels, Belhaven Harbor, 1946*

Draft (feet)	In-bound					Out-bound				
	Motor vessels	Sailing vessels	Barges	Tugs	Total	Motor vessels	Sailing vessels	Barges	Tugs	Total
10	40				40					
9	14				14					
8	12		41		53	12				12
7	15			41	56	29			41	70
6	65				65	40				40
5	225	175			400	65		41		106
4	295	130			425	225	175			400
3	885				885	1,180	130			1,310
2	1,620				1,620	1,620				1,620
Total	3,171	305	41	41	3,558	3,171	305	41	41	3,558
Total net registered tonnage	16,593	3,400	14,350	533	34,876	16,593	3,400	14,350	533	34,876

DIFFICULTIES ATTENDING NAVIGATION

46. Timber breakwaters completed in 1940 do not provide adequate protection for traffic in the harbor, especially for small vessels. South to east winds cause excessive wave action, thereby endangering boats, wharves, and personnel. Damage therefrom is discussed hereinafter in "estimates of benefits."

WATER POWER AND OTHER SPECIAL SUBJECTS

47. No question of irrigation, water supply, power, flood control, or other similar matters are involved in this report.

PLAN OF IMPROVEMENT

48. The most practicable plan of improvement would be to dredge a channel in Wynne's Gut 10 feet deep, with 2 feet overdepth, 60 feet wide, from the 10-foot contour in Pantego Creek to a turning basin of the same depth 100 feet wide and 250 feet long just north of East Front Street; thence a channel 10 feet deep, 60 feet wide, to a point near the southwest edge of East Main Street. The dredged material would probably be deposited in open water in Pantego Creek southwest of the 12-foot navigation channel. A 10-foot channel would serve most of the vessels calling at Belhaven; the larger vessels can safely tie up on the leeward side of the wharves in Belhaven Harbor during storms.

49. Rights-of-way, in addition to those furnished under previous local-cooperation provisions, will be required if the desired improvement in Wynne's Gut be approved. The town of Belhaven owns about 2.08 acres of land along the west bank of the gut. Town officials assured a representative of this office that the wood bridge spanning Wynne's Gut at East Front Street would be removed.

50. Improvement of Belhaven Harbor by new breakwaters or by modification of the existing timber breakwaters is also considered. Discussion of those improvements follows. Cost estimates for each plan are given hereinafter. Locations of the protective breakwaters herein considered are shown on the accompanying map.

(*a*) Plan A provides for a jetty northeast of the channel 280 feet long and a jetty southwest of the channel 1,100 feet long. The ends of

the jetties extend to near the edge of the 100-foot-wide channel but are not opposite each other. The benefits from this plan would accrue to navigation and to owners of commercial water-front property.

(*b*) Plan B provides for closing the base of the existing timber breakwaters by a dike and for extending the breakwaters channelward of their present offshore termini. The benefits from this plan would accrue to navigation and to the owners of water-front property.

AIDS TO NAVIGATION

51. One red beacon with a flashing white light, one red nun buoy, and two red spar buoys are alined along the northeast side of the existing channel; one black can buoy and four black spar buoys on the southwest side. As the dredged improvement in Wynne's Gut would be clearly marked by shore lines in solid ground, present aids to navigation appear adequate. If the improvement were provided and a need for additional aids developed, they would be relatively inexpensive. Therefore, the Coast Guard has not been consulted.

SHORE-LINE CHANGES

52. There would be no changes in shore lines from the desired improvement except those resulting directly from dredging.

ESTIMATES OF FIRST COST

53. Provision of a channel in Wynne's Gut 10 feet deep, with 2 feet overdepth, 60 feet wide, with a suitable turning basin (par. 48) would entail dredging about 36,000 cubic yards of earth. Contract dredging is estimated to cost $0.30 a cubic yard based on recent prices in this district. Estimates of Federal and non-Federal first costs follow:

Federal first costs:	
Dredging 36,000 cubic yards of earth at $0.30	$10, 800
Engineering, overhead, and contingencies, about 25 percent	2, 700
Total	13, 500
Non-Federal first costs:	
Setting aside space for public landing and furnishing rights-of-way and spoil-disposal areas	5, 000
Engineering, overhead, and contingencies, about 25 percent	1, 250
Total	6, 250
Total first costs:	
Federal	13, 500
Non-Federal	6, 250
Total	19, 750

54. Estimates of first cost of protecting the navigation channel and commercial water front by new jetties (plan A), and of an alternative plan for protecting the Belhaven shore line by modification of the existing jetties (plan B), as outlined in paragraph 50, are given below. Estimates for plan A jetties were prepared for both stone and creosoted-timber structures. The stone structures would be of trapezoidal cross section 3 feet wide at the top with side slopes of 1½ horizontal to 1 vertical and built to elevation 5.0 feet above mean

low water. The timber breakwaters would consist of three layers of 2- by 10-inch Wakefield piles supported between two sets of 6- by 8-inch horizontal wales on 4-foot centers and by vertical round-timber piles on 6-foot centers, all built to elevation 5.0 feet above mean low water. Estimates for modification of the existing breakwaters (plan B) were prepared for both sand and stone dikes at the base of the present structures. The sand dike would be pumped to elevation 0.2 above mean low water and would be capped with a 1.5-foot-deep layer of riprap. The 10-foot crown would be centered on the existing structure; the side slopes would be 15 horizontal to 1 vertical on the southeast side and 5 horizontal to 1 vertical on the northwest side. The stone dike would have a 5-foot crown centered on the existing structure at elevation 0.2 above mean low water. The side slopes would be 1½ horizontal to 1 vertical on the southeast side and 1 horizontal to 1 vertical on the northwest side. Both variants include extension of the existing timber breakwaters in their present alinement to within 50 feet of the navigation channel. Details of construction of plan A and plan B are shown on plate 2 [1] of the accompanying drawings. Contract costs are estimated to be: Plan A (stone), $11 a ton in place; plan A (timber), $5 a square foot in place; plan B (sand and riprap), $0.25 a cubic yard for sand dike in place and $12.50 a ton for riprap in place; plan B (stone), $12 a ton in place. Extension of the existing breakwaters is estimated to cost $50 a lineal foot. Estimates of Federal and non-Federal first costs follow:

Plan A (stone)

Federal first costs:	
28,600 tons of stone in place, at $11	$314, 600
Engineering, overhead, and contingencies, about 35 percent	110, 110
Total Federal first cost	424, 710
Non-Federal first costs:	
Furnishing rights-of-way	500
Engineering, overhead, and contingencies, about 25 percent	125
Total non-Federal first cost	625
Total first costs:	
Federal	424, 710
Non-Federal	625
Total	425, 335

[1] Not printed.

Plan A (timber)

Federal first costs:	
33,000 square foot timber breakwater in place, at $5	$165,000
Engineering, overhead, and contingencies, about 35 percent	57,750
Total Federal first cost	222,750
Non-Federal first costs:	
Furnishing rights-of-way	500
Engineering, overhead, and contingencies, about 25 percent	125
Total non-Federal first cost	625
Total first costs:	
Federal	222,750
Non-Federal	625
Total	223,375

Plan B (sand dike and riprap)

Federal first costs:	
78,100 cubic yards sand dike in place, at $0.25	19,525
3,310 tons of riprap in place at, $12.50	41,375
350 linear feet timber breakwater in place, at $50	17,500
Total	78,400
Engineering, overhead, and contingencies, about 35 percent	27,440
Total Federal first cost	105,840

Plan B (stone dike)

Federal first costs:	
19,720 tons of stone in place, at $12.50	246,800
350 linear feet timber breakwater in place, at $50	17,500
Total	264,300
Engineering, overhead, and contingencies, about 35 percent	92,500
Total Federal first cost	356,800

ESTIMATES OF ANNUAL CHARGES

55. The economic life of the project is estimated at 50 years. Replacement of timber breakwaters at the end of 25 years is provided for in average annual maintenance estimates. Federal annual charges are based on an interest rate of 3 percent, non-Federal 3.5 percent. No allowance is made for interest during construction because the estimated time for construction is less than a year. Increased annual cost of maintenance is estimated at $500 for the 10-foot channel in Wynne's Gut, $2,500 for plan A stone breakwaters, $2,000 for plan A timber breakwaters, $2,500 for plan B sand dike and riprap, and $2,000 for plan B stone dike. Estimates of annual charges follow:

Federal annual charges on 10-foot channel in Wynne's Gut:	
Interest, 3 percent on $13,500	$410
Amortization, 0.887 percent on $13,500	120
Increased maintenance	500
Total	1,030
Non-Federal annual charges on 10-foot channel in Wynne's Gut:	
Interest, 3.5 percent on $6,250	220
Amortization, 0.763 percent on $6,250	50
Total	270

Total annual charges on 10-foot channel in Wynne's Gut:		
Federal		$1,030
Non-Federal		270
Total		1,300
Plan A (stone)		
Federal annual charges:		
Interest, 3 percent on $424,710		12,740
Amortization, 0.887 percent on $424,710		3,770
Increased maintenance		2,500
Total Federal annual charges		19,010
Non-Federal annual charges:		
Interest, 3.5 percent on $625		20
Amortization, 0.763 percent on $625		5
Total non-Federal annual charges		25
Total annual charges:		
Federal		19,010
Non-Federal		25
Total		19,035
Plan A (timber)		
Federal annual charges:		
Interest, 3 percent on $222,750	$6,680	
Amortization, 0.887 percent on $222,750	1,975	
Subtotal		8,655
Maintenance and operation including replacement:		
Increased maintenance	$2,000	
Interest, 3 percent on $106,390 (present worth of $222,750 in 25 years)	3,190	
Amortization, 0.887 percent on $106,390	945	
Subtotal		6,135
Total Federal annual charges		14,790
Non-Federal annual charges:		
Interest, 3.5 percent on $625		20
Amortization, 0.763 percent on $625		5
Total non-Federal annual charges		25
Total annual charges:		
Federal		14,790
Non-Federal		25
Total		14,815
Plan B (sand dike and riprap)		
Federal annual charges:		
Interest, 3 percent on $105,840		3,175
Amortization, 0.887 percent on $105,840		940
Increased maintenance		2,500
Total Federal annual charges		6,615
(Plan B (stone dike)		
Federal annual charges:		
Interest, 3 percent on $356,800		10,705
Amortization, 0.887 percent on $356,800		3,165
Increased maintenance		2,000
Total Federal annual charges		15,870

ESTIMATES OF BENEFITS

56. Dredging the channel and turning basin in Wynne's Gut, constructing new breakwaters in Belhaven Harbor, or modifying the existing breakwaters would effect no reduction in freight rates. Benefits would be derived from increased safety and convenience for established navigation, and reduction of damage to boats, wharves, warehouses, and water front by wave action. Such improvements might also increase the use of the harbor. In estimating costs or benefits, no cognizance was taken of possible minor improvement of Wynne's Gut by local interests (par. 29). If such improvement be made it might somewhat decrease the first cost to the Federal Government; it might also decrease the estimated benefits from Federal improvement. However, it is believed that such improvement by local interests would not appreciably affect average annual charges or benefits over the estimated 50-year economic life of the Federal improvements considered in this report.

57. According to available information, about 100 boats are owned and operated at Belhaven. About 75 of them, including 3 trawlers, are used for crabbing, oystering, fishing, and other purposes. The majority of those vessels are about 32 feet long, but some are about 60 feet long. The remaining 25 are small recreational vessels.

58. Estimates of storm damages are based on figures obtained from local interests for three relatively severe storms in Belhaven. The damages include only those that could be prevented or decreased by such improvements as are considered in this report. They do not include other storm damages, such as wind damage to buildings so located that they could not be helped by such improvements. Damages are based on present values, costs, and conditions, including the existence of the breakwaters at the mouth of Pantego Creek. Total damages, based on present conditions, for the three storms are as follows:

	Maximum wind velocity (miles per hour)	Boat damage	Total damage
September 1913	80	$13,250	$58,750
September 1933	57	4,500	7,000
September 1944	56	3,800	7,500

Although occasional damage may occur at lower velocities, substantial damage is estimated to begin with a wind velocity of 40 miles an hour.

59. *Wind velocity-frequency curves.*—Wind velocity-frequency curves for maximum monthly wind velocities at Hatteras and Belhaven for the period 1913 through 1945 are shown on plate 2 [1] of this report. Wind velocities at Belhaven were determined by comparing the velocity and direction of maximum monthly wind velocities as recorded at the United States Weather Bureau Station, Hatteras, N. C., with similar data recorded the same day at various Weather Bureau stations in North Carolina and Virginia, basing the estimated velocities at Belhaven upon relative distances from storm centers and other factors, as determined by a study of Monthly Weather Reviews and accounts of storm damages in newspaper articles.

[1] Not printed.

60. *Wind velocity-damage curves.*—Wind velocity-damage curves were drawn (pl. 2 [1]) using the data given in paragraph 58. Consideration was given to the total value of boats and property along the water front in drawing the upper part of the curve.

61. *Average annual damages.*—Damage-frequency curves for total damage and boat damage were plotted from the wind velocity-frequency curves and wind velocity-damage curves described above, using the following method:

(*a*) Select a frequency in years and convert to percent chance of being equaled or exceeded.

(*b*) Select wind velocity from the Belhaven wind velocity-frequency curve which compares with the frequency value selected in (*a*).

(*c*) Apply the wind-velocity value selected in (*b*) to the wind velocity-damage curves to obtain the damage value.

(*d*) Plot the damage value (*c*) against the percent chance of being equaled or exceeded (*a*) to determine a point on the damage-frequency curve.

(*e*) Repeat the process until enough points have been determined to define the curves.

The average annual damages are the areas under each of the damage-frequency curves shown on plate 2 [1].

62. From the curves it is found that the total average annual damage caused by winds from any direction is about $8,000 and the average annual damage to boats is about $4,200. The average annual damage to wharves and water-front property is the difference, or about $3,800. Local interests state that the greatest damage results from wave action caused by winds from the southeast quadrant. This statement seems well founded, inasmuch as the fetch is greatest in that direction and the existing breakwaters only partially obstruct wave action. Wave action caused by winds from other directions is less severe because of the shorter fetches and because of protective shoal areas in Pantego Creek. However, because enough data are not available, no breakdown is made of damages based on wind direction. Average annual damages from winds from any direction under present conditions and the average annual damages that would accrue if the present breakwaters were not in place are estimated below. The damages prevented by the existing breakwaters are estimated at an average of $1,000 a year (par. 63).

Estimated average annual damages

	Total damage	Damage to boats	Damage to wharves and water front
Under present conditions	$8,000	$4,200	$3,800
Without existing breakwaters	9,000	4,700	4,300

63. Local interests state that the existing timber breakwaters have somewhat improved harbor conditions, but have not provided the protection needed. The average annual damages prevented by the existing breakwaters are estimated at $1,000. It is assumed that the United States will continue to maintain the present breakwaters in reasonably good condition until some alternative modification of the project providing breakwaters shall be adopted. To justify new

[1] Not printed.

breakwaters, they should produce benefits in excess of those produced by the existing breakwaters, sufficient to warrant abandonment of the existing breakwaters and construction of the new ones. To warrant modification of the existing breakwaters to more completely stop wave action the modification should produce benefits in excess of those produced by the existing breakwaters, sufficient to justify the cost of modification.

64. It is estimated that the various improvements, if provided, would result in benefits as follows:

(*a*) A channel in Wynne's Gut would form a landlocked harbor which would afford protection to boats during storms from any direction. With a channel 10 feet deep, 60 feet wide, and about 1,200 feet long, all but a few of the larger craft at Belhaven could seek refuge in the gut during storms. It is estimated that about 75 percent of the present average annual storm damage to boats, amounting to about $3,150, would be prevented by a harbor in Wynne's Gut. That damage is based on the assumption that the present breakwaters would be maintained and would continue to prevent about $1,000 damage a year.

(*b*) If new breakwaters were constructed closer to the Belhaven commercial water-front area, the major portion of damage to boats, wharves, and commercial water-front property would be prevented. The residential water front east of Edward Street would not be protected, but average annual damage in that area is small compared with the total damage to wharves and the commercial water front. During severe storms small craft would still be subject to some damage. If the existing breakwaters were abandoned, it is estimated that the new breakwaters would prevent about 70 percent of the wharf and water-front average annual damage ($3,010) and about 50 percent of the boat damage ($2,350), a total of $5,360. The existing jetties cost some $70,000 in 1940; the cost of their replacement in kind under present and prospective conditions would be about $150,000. If the cost of their periodic maintenance through the 50-year economic life of the new project would aggregate the cost of one complete replacement of the structures, the average annual cost of maintenance would be $3,000. If new breakwaters be provided and the existing breakwaters abandoned, the total benefits should include the $3,000 of future average annual maintenance of existing jetties which would not be required. Average annual benefits would total $8,360.

(*c*) New breakwaters nearer the commercial water front and a harbor in Wynne's Gut would provide protection for the smaller boats, for the larger boats unable to enter Wynne's Gut, and for the wharves and commercial water front. As in the case with new breakwaters alone, it is assumed that the existing breakwaters would be abandoned if new breakwaters were provided. It is estimated that such an improvement would prevent about 75 percent of the average annual damage to the wharves and water front ($3,225) and about 90 percent of the damage to boats ($4,230), a total of $7,455; including as benefits the cost of maintaining the existing breakwaters throughout the life of the project increases the benefits to $10,455. If the benefits from improving Wynne's Gut be given priority the average annual benefits from providing the new breakwaters would be the difference between the damages prevented by the combined project ($7,455) and those

from improvement of Wynne's Gut ($3,150) plus the $3,000 average annual cost of maintaining the existing breakwaters, or $7,305.

(*d*) If the existing timber breakwaters be modified (plan B) to more completely stop wave action, there would be less storm damage along the residential water-front area. Relatively small benefits, however, would be realized by the owners of wharves, boats, or water-front property in the commercial area of Belhaven because the average distance from the breakwaters to the wharves at Belhaven is 0.6 mile, enough to allow the building up of waves high enough to cause damage (par. 13). The average annual damage prevented by the existing breakwaters is estimated as $1,000. It is estimated that those breakwaters, if modified to more completely stop wave action, would prevent additional average annual damages of about $1,000 to boats, wharves, and water-front property, or a total of $2,000.

(*e*) Modification of the existing breakwaters and a harbor in Wynne's Gut would provide protection for the smaller boats, some additional protection for the larger boats unable to enter Wynne's Gut and for the wharves and water-front area. The benefits from those improvements would be almost entirely separate, and the combined average annual benefits are therefore estimated at $500 less than the sum of the individual benefits ($3,150 from improvement of Wynne's Gut and $1,000 from modification of existing breakwaters), or at $3,650. If the benefits from improving Wynne's Gut be given priority the average annual benefits from modifying the existing breakwaters would be the difference between the damages prevented by the combined project ($3,650) and those from improvement of Wynne's Gut ($3,150), or $500.

65. Consideration was also given to the construction of new breakwaters which would provide shore protection to the eastern or residential water front in Belhaven in addition to protecting shipping and the commercial water front. Such structures would be considerably longer and more costly than the plan A breakwaters and would protect areas where Federal interests are small or nonexistent. For that reason substantial contributions by local interests should be made if such an improvement were provided. However, since the ratio of benefits to costs from such an improvement would be considerably lower than for the plan A breakwaters, further consideration of the plan seems unnecessary.

66. The benefits estimated for various plans of improvement are tabulated below:

Average annual benefits

	Damages prevented	Maintenance of existing breakwaters	Total
Improvement of Wynne's Gut	$3,150	----------	$3,150
Plan A breakwaters	5,360	$3,000	8,360
Improvement of Wynne's Gut plus plan A breakwaters	7,455	3,000	10,455
Benefits from plan A breakwaters if priority in benefits be given to improvement of Wynne's Gut	4,305	3,000	7,305
Modification of present breakwaters (plan B)	1,000	----------	1,000
Improvement of Wynne's Gut plus modification of present breakwaters	3,650	----------	3,650
Benefits from modification of present breakwaters if priority in benefits be given to improvement of Wynne's Gut	500	----------	500

COMPARISON OF BENEFITS AND COSTS

67. Annual benefits, charges, and the ratio of benefits to charges for the improvements herein considered are given in table 8.

TABLE 8.—*Comparison of benefits and costs*

Improvement	Benefits	Annual charges	Benefit-cost ratio
Improvement of Wynne's Gut	$3,150	$1,300	2.42
Plan A, stone breakwaters	8,360	19,035	0.44
Improvement of Wynne's Gut plus stone breakwaters	10,455	20,335	0.51
Stone breakwaters if priority in benefits be given to improvement of Wynne's Gut	7,305	19,035	0.38
Plan A, timber breakwaters	8,360	14,815	0.56
Improvement of Wynne's Gut plus timber breakwaters	10,455	16,115	0.65
Timber breakwaters if priority in benefits be given to improvement of Wynne's Gut	7,305	14,815	0.49
Plan B, modification of existing breakwaters (sand dike and riprap)	1,000	6,615	0.15
Improvement of Wynne's Gut plus modification of existing breakwaters (sand dike and riprap)	3,650	7,915	0.46
Modification (sand dike and riprap) if priority in benefits be given to improvement of Wynne's Gut	500	6,615	0.08
Plan B, modification of existing breakwaters (stone)	1,000	15,870	0.06
Improvement of Wynne's Gut plus modification of existing breakwaters (stone)	3,650	17,170	0.21
Modification (stone) if priority in benefits be given to improvement of Wynne's Gut	500	15,870	0.03

PROPOSED LOCAL COOPERATION

68. The benefits from the improvements considered would be widely distributed; they would accrue to local and transient navigation interests and to the owners of wharves, warehouses, and water-front property. However, since all improvements considered except the improvement of Wynne's Gut have unfavorable benefit-cost ratios, the discussion of proposed local cooperation is limited to that plan.

69. For the improvement of Wynne's Gut it is proposed that local interests be required to provide, free of cost to the United States, as and when required, all lands, easements, rights-of-way, and spoil-disposal areas for the initial work and for subsequent maintenance; hold and save the United States free from claims for damage that may result from the provision and maintenance of the improvement; provide and maintain suitable space for a public landing in Wynne's Gut, open to all on equal terms; and remove the wood bridge across Wynne's Gut at East Front Street. The town of Belhaven owns about 2 acres of land on the west side of Wynne's Gut. Town officials at the hearing, and otherwise, have indicated that the town of Belhaven would fulfill the provisions of local cooperation if the improvement of Wynne's Gut were provided.

70. Although considerable sentiment was expressed at the public hearing for maintaining the former public dock, the preponderance of opinion seemed to be that, if Wynne's Gut were improved and a satisfactory public landing provided there, there would be no need for the public dock in Belhaven Harbor. In the opinion of this office, the improvement of Wynne's Gut should not be contingent on local interests maintaining a public wharf in Belhaven Harbor.

ALLOCATION OF COSTS

71. For all improvements considered, Federal costs would be paid from funds appropriated for expenditure by the Corps of Engineers, Department of the Army. In the proposed plan of improvement of Wynne's Gut, Federal first costs are estimated at $10,800 for dredging and $2,700 (about 25 percent) for engineering, overhead, and contingencies, a total of $13,500. Increased annual cost of maintenance, to be borne by the Federal Government, is estimated at $500. Non-Federal first costs for the improvement of Wynne's Gut, to be borne by local interests, are estimated at $5,000 for rights-of-way and spoil-disposal areas and $1,250 (about 25 percent) for engineering, overhead, and contingencies, a total of $6,250. Since the benefits from the proposed improvement would be widely distributed, it is believed that local interests should be required to participate in the improvement only to the extent outlined in paragraph 69.

COORDINATION WITH OTHER AGENCIES

72. Letters were sent to the following, requesting advice of any interest they might have in the report:

Governor of North Carolina, Raleigh, N. C.
Beaufort County Board of Commissioners, Washington, N. C.
Federal Power Commission, Atlanta, Ga.
National Park Service, Richmond, Va.
United States Soil Conservation Service, Spartanburg, S. C.
United States Geological Survey, Raleigh, N. C.
United States Public Roads Administration, Spartanburg, S. C.
United States Fish and Wildlife Service, Atlanta, Ga.
United States Forest Service, Atlanta, Ga.
United States Public Health Service, Atlanta, Ga.

Copies of replies received are enclosed as appendix A[1] and are summarized below:

(*a*) The Governor of North Carolina referred the matter to the State Director of Conservation and Development, who expressed general interest.

(*b*) The board of county commissioners did not reply nor were they present at the public hearing.

(*c*) The United States Public Health Service recommended placing of spoil in such a manner as not to block existing drainage.

(*d*) No replies were received from the United States Public Roads Administration and the United States Fish and Wildlife Service.

(*e*) The other agencies replied that they were not interested in the investigation.

DISCUSSION

73. Local interests request that the United States provide a channel 10 feet deep in Wynne's Gut and/or more adequate protection by means of breakwaters in the harbor at Belhaven. Consideration has been given to providing the desired channel in Wynne's Gut, to constructing new breakwaters closer to the harbor area, and to modifying the existing breakwaters.

74. The statement of local interests that the existing timber breakwaters do not provide adequate protection for Belhaven Harbor seems

[1] Not printed.

well founded. Those structures are permeable and therefore do not completely obstruct wave action. However, even though they were modified to completely obstruct wave action, it is believed they would not provide the protection needed. The existing structures are about 0.6 mile southeast of the commercial water-front area. In that distance strong southeast winds would create waves high enough to disrupt loading or unloading operations on larger vessels and to endanger and damage smaller craft. Computations indicate that the benefits to be derived from modifying the existing timber breakwaters would not be commensurate with the cost of such improvement.

75. New breakwaters of stone or timber (plan A) would protect navigation and the commercial water front from wave action caused by southeast winds. A 10-foot-deep channel in Wynne's Gut would furnish ample protection for nearly all boats from winds from any direction. If only the channel in Wynne's Gut were provided, the wharves and water-front property would still be unprotected. Construction of breakwaters closer to the harbor area and a channel in the gut would afford protection for all navigation interests at Belhaven. However, the estimated additional benefits from breakwater construction are incommensurate with costs.

76. Belhaven Harbor is a natural harbor of refuge for navigation on Pamlico River and the south end of Pamlico Sound. It is the only port between Norfolk, Va., and Morehead City, N. C., whose depth is equivalent to that of the Intracoastal Waterway (12 feet) where rail, bus, communication, maintenance facilities, and supplies are available to boat operators. Belhaven is 130 miles south of Norfolk and 66 miles north of Morehead City and is, therefore, a logical overnight stopping place for vessels traversing the waterway.

77. The most practicable improvement would be a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot contour in Pantego Creek to a turning basin of the same depth 100 feet wide and 250 feet long just north of East Front Street; thence a channel 10 feet deep and 60 feet wide to a point near the southwest edge of East Main Street in Belhaven. Federal first cost of such improvement would be $13,500 and non-Federal $6,250, a total of $19,750. Annual evaluated benefits are estimated at $3,150 and the annual charges at $1,300, giving a benefit-cost ratio of 2.42.

78. The proposed improvement in Wynne's Gut would provide greater protection to fishing boats, pleasure craft, and other small vessels during storms, relieve congested mooring space at private docks, provide a safer area for loading and unloading boat cargoes, and might increase the number of vessels calling at Belhaven.

79. Improvements such as that proposed tend to make for safer navigation, fewer accidents, less damage, and, therefore, to reduce the cost of marine insurance.

80. The improvement is justified in the interest of the safety and convenience of established and prospective navigation.

81. Local interests appear greatly interested in the proposed improvement in Wynne's Gut and are making plans to provide wharves, water, fuel, and refuse-disposal service for all types of vessels that may use the channel and facilities.

82. The benefits from the proposed improvement would be widely distributed. It is therefore considered that local interests should be

required to participate in the construction only to provide, free of cost to the United States, as and when required, all lands, easements, rights-of-way, and spoil-disposal areas for the initial work and for subsequent maintenance; hold and save the United States free from claims for damage that may result from the provision and maintenance of the improvement; provide and maintain suitable space for a public landing in Wynne's Gut open to all on equal terms; and remove the wood bridge across Wynne's Gut at East Front Street.

CONCLUSIONS

83. The district engineer concludes that benefits from the modification of the present breakwaters in Belhaven Harbor or from the construction of new breakwaters nearer the harbor would not be commensurate with costs. He finds, however, that a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot contour in Pantego Creek to a turning basin of the same depth 100 feet wide and 250 feet long just north of East Front Street, thence 10 feet deep and 60 feet wide to a point near the southwest edge of East Main Street in Belhaven, would reasonably meet the needs of present and prospective navigation and is warranted. The first cost to the United States is estimated at $10,800 for dredging and $2,700 for engineering, overhead, and contingencies, a total of $13,500. If the proposed improvement be approved, the necessary funds should be provided in a single appropriation to secure the most economical and advantageous prosecution of the work.

RECOMMENDATION

84. The district engineer recommends that the existing Federal project for Belhaven Harbor, N. C., be modified to provide for a channel in Wynne's Gut 10 feet deep and 60 feet wide from the 10-foot contour in Pantego Creek to a turning basin of the same depth 100 feet wide and 250 feet long just north of East Front Street, thence 10 feet deep and 60 feet wide to a point near the southwest edge of East Main Street, in Belhaven, all substantially as shown on the accompanying map, at an estimated first cost to the United States of $13,500 for dredging and $500 annually for maintenance in addition to that now authorized (to be expended by the Corps of Engineers); provided that local interests furnish, free of cost to the United States, as and when required, all lands, easements, rights-of-way, and spoil-disposal areas for the initial work and for subsequent maintenance; hold and save the United States free from claims for damage that may result from the provision and maintenance of the improvement; provide and maintain a suitable public landing in Wynn's Gut open to all on equal terms; and remove the wood bridge across Wynne's Gut at East Front Street.

H. R. Cole,
Colonel, Corps of Engineers, District Engineer.

[First endorsement]

OFFICE, DIVISION ENGINEER,
SOUTH ATLANTIC DIVISION,
Atlanta, Ga., January 12, 1949.

Subject: Review of reports on Belhaven Harbor, N. C.

To: The Chief of Engineers, Department of the Army, Washington, D. C.

The division engineer concurs in the recommendation of the district engineer.

MASON J. YOUNG,
Colonel, Corps of Engineers, Division Engineer.

LIST OF APPENDIXES MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

(Not printed)

A. Coordination with other agencies.
B. Cost estimates.

LIST OF ILLUSTRATIONS MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

(Only plate 1 printed)

1. Vicinity map.
2. Benefit analysis curves and typical breakwater sections.

○

(CORPS OF ENGINEERS U. S. ARMY

BELHAVEN HARBOR, N. C.

IN 2 SHEETS SHEET NO. I SCALE IN FEET

200 0 2 4 6 8 10 12 14 16 1800

WILMINGTON DISTRICT, CORPS OF ENGINEERS, WILMINGTON, N.C. OCTOBER 1948

SUBMITTED:	APPROVAL RECOMMENDED:	APPROVED:
N.C. Magnuson	T. S. Hewitt	H. R. Sola
Chief, P.E. and R. Report Branch	Chief, Engineering Division	Colonel, Corps of Engineers

Drawn by: D. J. L.
Checked by: N.C.M.

To accompany Review Report dated: October 27, 1948

FILE BH 15

PLATE I

96396 O - 52 (Inside back cover)

EXISTING CHANNEL 12' X 100'
IMPROVEMENT DESIRED
CHANNEL 10' X 50'-70', AND RECONSTRUCTION OF BREAKWATERS USING STONE
IMPROVEMENT RECOMMENDED
CHANNEL 10' X 60' WITH TURNING BASIN 100' WIDE AND 250' LONG

PANTEGO CREEK
PUNGO RIVER
BELHAVEN
EAST FRONT STREET (PROPOSED)
EAST MAIN STREET
ALLEN ST.
PAMLICO ST.
HASLIN ST.
EDWARD ST.
MAGNOLIA ST.
RIVER VIEW ST.
WEST MAIN STREET
EXISTING CHANNEL 12' X 100'
APPROXIMATE BOUNDARY OF LAND OWNED BY TOWN OF BELHAVEN
Wood bulkhead
Wood bridge
Sinclair Oil Co.
Texaco Oil Co.
Oil Dock
PLAN A
BREAKWATERS CONSIDERED
Timber breakwater
7-Pile dolphin
Red light
SCALE IN FEET 0 200 400

VICINITY MAP
SCALE IN MILES 50 0 50 100

LOCATION MAP
SCALE IN MILES 10 0 10 20 30

SCALE OF VELOCITIES
Indicated by width of lines
0 to 15 M P H
16 to 25 M P H
26 to 35 M P H
36 to 45 M P H
Over 45 M P H

60 days

DIRECTION AND VELOCITY OF WINDS
Direction is indicated by arrows, velocity by width, and frequency by length of shaded lines.
Compiled from the daily maximum readings of the U.S. Weather Bureau at Hatteras, N. C.
Mean of 5 years readings, 1932 through 1936.

Soundings refer to U. S. C. & G. S. low water datum
Surveyed May 1946

- DREDGED CHANNEL
- AREA CLOSER TO BELHAVEN HARBOR THAN TO ANY OTHER PORT
- PUNGO RIVER DRAINAGE BASIN ABOVE MOUTH OF PANTEGO CREEK
- COUNTY LINE
- RAILROAD - SINGLE TRACK
- 6-FOOT CONTOUR
- 10-FOOT CONTOUR
- 12-FOOT CONTOUR
- FEDERAL HIGHWAY
- STATE HIGHWAY
- STATE LINE
- PROPOSED STREET
- APPROX. BOUNDARY OF LAND OWNED BY TOWN OF BELHAVEN
- BREAKWATERS CONSIDERED
- BREAKWATER EXTENSIONS CONSIDERED